

CLAIMS

We hereby claim:

1. An apparatus for producing a composite plank comprising:
 - a) an extruder;
 - b) a plurality of dies after the extruder;
 - c) a cylinder after the extruder, the cylinder including an orifice for injecting a gas into a material;
 - d) a lubricating assembly to shape and form a composite plank from the material;
 - e) a cooling tank after the device;
 - f) a conveyor having opposing belts for pulling the plank through the cooling tank;
 - g) a saw connected to the conveyor; and
 - h) a stacking table adjacent the saw.
2. The apparatus of claim 1, wherein the cylinder is pressurized and contains a plurality of pins located in the center of the orifice and between two channels so that material extruded therein is uniformly injected with gas to cause it to foam before moving into a die.
3. The apparatus of claim 1, wherein the cylinder is located outside of the extruder to better control the amount of a) pressure present therein and b) gas added to the orifice to produce a better, more consistent end product.
4. The apparatus of claim 1, wherein pins in the cylinder allow gas to flow into the cylinder and prevent backflow into the pins.
5. The apparatus of claim 1, wherein the cylinder adds a high pressure gas between dies and is not located inside of the extruder.
6. The apparatus of claim 1, wherein the assembly applies heating and cooling to the plank.
7. The apparatus of claim 1, wherein the dies comprise an adapter die, a transition die, a stranding die, a molding die and a setting die.
8. The apparatus of claim 1, wherein the cylinder is mounted after an adapter die.
9. The apparatus of claim 1, wherein the cylinder is mounted before a transition die.
10. The apparatus of claim 1, wherein the assembly includes at least one of a

temperature controller and a lubricator connected to the.

11. The apparatus of claim 1, further comprising at least one of: a gas generator, a pressure booster, and a temperature controller connected to the cylinder.
12. The apparatus of claim 1, where the assembly acts as a molding cooler to quickly lower the temperature of the extruded material and thus shape the outer profile of the plank.
13. The apparatus of claim 1, wherein the assembly aids in forming an outer skin to the plank, sealing the plank and making the surface of the plank smooth.
14. The apparatus of claim 1, further comprising a tempering block connected to the assembly so that the extruded material can continue to expand to a preferred size in a controlled environment before being heated or cooled.
15. A system for making a wood and plastic composite comprising:
 - a) a hopper for receiving wood and plastic material;
 - b) a device for mixing the material;
 - c) at least one die for shaping the material after exiting the mixing device;
 - d) a pressurized container outside of the device for injecting gas into the material to create a foam-like plank;
 - e) a calibrator for shaping the plank through heating and cooling;
 - f) a tank for further cooling the plank; and
 - g) a conveyor for carrying the plank through the tank.
16. The system of claim 1, wherein the pressurized container includes a plurality of pins located in the center of two channels so that material therein is injected with gas; wherein the calibrator quickly lowers the temperature of the material to shape the outer profile of it into a plank.
17. The system of claim 1 where the calibrator aids in forming an outer skin to the plank, sealing the plank and making the surface of the plank smooth.
18. The system of claim 1 wherein the container is located outside of the extruder to better control the amount of a) pressure present therein and b) gas added to the orifice to produce a better, more consistent end product.
19. The system of claim 1 wherein pins in the cylinder allow gas to flow into the

cylinder and prevent backflow into the pins.

20. The system of claim 1

wherein the cylinder adds a high pressure gas between dies and is not located inside of the extruder.

21. The system of claim 1 wherein the calibrator applies heating and cooling to the plank.

22. The system of claim 1 wherein the dies comprise an adapter die, and then a transition die, a stranding die, and a molding die.

23. The system of claim 1 wherein the cylinder is after an adapter die and before a transition die.

24. The system of claim 1 further comprising: at least one of a temperature controller and a lubricator connected to the calibrator; at least one of a gas generator, a pressure booster, and a temperature controller connected to the container; and a tempering block connected to the calibrator so that the extruded material can continue to expand to a preferred size in a controlled environment before being heated or cooled.

25. A method of manufacturing a plank comprising the steps of:

- a) placing a material in a hopper;
- b) mixing and then extruding the material from an extruder;
- c) injecting gas from a device located outside of the extruder, said gas being injected into the material to create foaming in the material
- d) shaping the extruded material with at least one die into a plank;
- e) tempering the plank in a controlled environment to maximize foaming;
- f) calibrating the shape and size of the plank through at least heating;
- g) cooling the plank further; and
- h) conveying the plank to a saw for further sizing

26. A process of making a composite comprising the steps of:

a. mixing finely ground wood flour with plastic in an extruder to form a plasticated mixture;

introducing a blowing agent into the plasticated material outside of the extruder under

- low pressure;
- developing sufficient pressure to drive the blowing agent into the plasticated mixture to form cells within the plasticated mixture, wherein the blowing agent is incorporated under a pressure gradient in the extruder sufficient to increase the solubility of the blowing agent in the plasticated mixture and under a temperature sufficient to prevent collapse of the cells; and reducing the pressure prior to removing the plasticated mixture from the extruder.
27. The process of claim 26 wherein the wood flour is selected from the group consisting of wood flour, sawdust, pond sludge, newspapers, alfalfa, wheat pulp, wood chips, wood flakes, wood fibers, ground wood, wood veneers, wood laminates, kenaf, paper, cardboard, and straw.
28. The process of claim 26 wherein the wood flour is selected from hard and soft wood. and has a particle size no greater than about 40 mesh.
29. The process of claim 26 wherein the wood flour has a particle size no greater than about 60 mesh.
30. The process of claim 26 wherein the moisture content of the wood flour is between about 1% and 9%.
31. The process of claim 26 wherein the moisture content of the wood flour is no more than about 2%.
32. The process of claim 26 wherein the thermoplastic materials are selected from the group consisting of polyethylene, polypropylene, poly-vinyl chloride, low-density polyethylene, ethyl-vinyl acetate and waste plastic sawdust.
33. The process of claim 26 wherein the thermoplastic materials are selected from the group consisting of high-density polyethylene and polypropylene.

34. The process of claim 26 wherein the ratio of wood fibers to the thermoplastic material is between approximately 3:2 and 1:4.
35. The process of claim 26 wherein the ratio of wood fibers to the thermoplastic material is approximately 2:3.
36. The process of claim 26 wherein the blowing agent is selected from the group consisting of air and carbon dioxide.
37. The process of claim 26, wherein the pressure gradient is 5 between 1400 psi and 3800psi.
38. The process of claim 3, where the temperature of the extrudate is controlled at a level between about 5 and 15 °F (2.7 and 8.3°C) above the crystallization temperature of the plasticated mixture.
39. A process for producing plastic/*wood* fiber composite foamed structures comprising the steps of: pre-drying *wood* fiber filler to produce dried *wood* fiber filler; mixing the dried *wood* fiber filler with plastic to produce a plastic/*wood* fiber mixture; feeding the plastic/*wood* fiber mixture into an extruder; mixing a physical blowing agent into the plastic/*wood* fiber mixture after the extruder to produce a plastic/*wood* fiber/gas mixture; subjecting the plastic/*wood* fiber/gas mixture to high shear forces in the presence of high pressures; and producing a plastic/*wood* fiber composite foamed structure.
40. The process of claims 39, further comprising the steps of: maintaining the pre-drying temperature below the degradation temperature to produce dried *wood* fiber filler which has a degradation temperature and an active volatilization temperature; maintaining the mixing temperature below an active volatilizing temperature; maintaining the processing temperature below an active volatilizing temperature.